CLAIMS

What is claimed is:

1. A system for recharging and communicating with a body implanted stimulator having a rechargeable battery comprising:

a chair pad;

a base station that is electrically connectable to the chair pad; and

an antenna/charging coil that is used to inductively charge the rechargeable battery with the implanted stimulator and to transcutaneously communicate with the stimulator,

wherein the antenna/charging coil is placed inside the chair pad.

2. The system of claim 1, further comprising:

circuitry for accomplishing forward and backward frequency shift keying (FSK) telemetry with the implanted stimulator,

wherein the antenna/charging coil is configured and dimensioned to enable FSK telemetry.

3. The system of claim 2, further comprising:

circuitry for accomplishing forward on-off keying (OOK) telemetry with the implanted stimulator using the antenna/charging coil.

4. The system of claim 1, further comprising:

a current measuring circuitry for determining power consumption in the antenna/charging coil.

5. The system of claim 4, further comprising:

an automatic power shut-off circuitry for automatically shutting off power to the antenna/charging coil when the power consumption through the antenna/charging coil exceeds a predetermined level.

5. The system of claim 1, further comprising:

a printed circuit board (PCB) contained in the chair pad; and

a sensing circuitry for sensing temperature included on the PCB.

6. The system of claim 5, further comprising:

an automatic power shut-off circuitry for automatically shutting off power to the antenna/charging coil when the sensed temperature through the antenna/charging coil exceeds a predetermined level.

7. The system of claim 1, further comprising:

a booster coil inside the chair pad that is used for zero-volt battery recovery (ZVR).

8. The system of claim 7, wherein the booster coil has about 6 turns of multi-stranded Litz wire in 2 layers of 3 turns each, wrapped around a coil spool.

9. The system of claim 7, further comprising:

a power sensing circuitry for determining power consumption in the booster coil; and

an automatic power shut-off circuitry for automatically shutting off power to the booster coil when the power consumption through the booster coil exceeds a predetermined power level.

10. The system of claim 7, further comprising:

a printed circuit board (PCB) contained in the chair pad;

a sensing circuitry for sensing temperature included on the PCB; and

an automatic power shut-off circuitry for automatically shutting off power to the booster coil when the sensed temperature through the booster coil exceeds a predetermined power level.

11. The system of claim 1, wherein the antenna/charging coil has about 24 turns of multi-stranded Litz wire wrapped around a 200 mm inside diameter coil spool.

12. The system of claim 1, wherein the chair pad is further comprised of:

a compliant chair pad housing made of polyurethane foam;

a chair pad printed circuit board (PCB); and

a coil assembly housing which contains a booster coil, the antenna/charging coil and the chair pad PCB,

wherein the polyurethane foam housing encapsulates the coil assembly housing.

13. The system of claim 12, wherein the chair pad is further comprised of:

padding that surrounds the polyurethane foam housing; and

an exterior slipcover that surrounds the padding.

14. The system of claim 1, further comprising:

a booster coil that is placed in a coil assembly with the antenna/charger coil, wherein the booster coil and antenna coil are wound over a spool coil in a configuration to present at least one substantially flat side; and

a coil shield which is grounded and which shield is placed as part of the coil assembly to substantially cover the antenna/charger coil and the booster coil,

wherein the coil assembly is fully encapsulated in a housing, which housing is contained within the chair pad.

15. The system of claim 14, wherein the housing is polyurethane foam and has approximate dimensions that are about or smaller than 50 cm by 50 cm by 15 cm thick.

16. The system of claim 1, further comprising:

a chair pad cable that connects the chair pad to the base station; and

detection circuitry for automatically detecting disconnection of the chair pad cable from the chair pad.

17. The system of claim 9, wherein the base station includes:

a speaker for generating an audible sound to signal a significant system event.

18. The system of claim 1, further comprising:

a booster coil for use in zero volt battery recovery (ZVR); and

first and second impedance matching networks,

wherein a first amplifier power supply to the antenna/charging coil is impedance matched with the first impedance matching network; and

wherein a second amplifier power supply to the booster coil is impedance matched with the second impedance matching network.

19. The system of claim 18, wherein the first impedance matching network is a 50 Ohm matching network and the second impedance matching network is a 50 Ohm matching network.

20. The system of claim 1, wherein the implantable stimulator is a microstimulator having a maximum length-wise dimension of about 3.5 centimeters and a maximum width of about 5 millimeters.

21. The system of claim 1, further comprising:

a sensor for detecting power levels in the antenna/charging coil; and

a variable output power supply that automatically adjusts downwards when the power levels detected by the sensor detects power levels that exceed a predetermined levels,

wherein the variable output power supply is contained within the base station.

22. The system of claim 21, wherein the variable output power supply ranges from between about +7 to + 20 VDC.

23. The system of claim 1, wherein all voltages and currents inside the chair pad are below about 4.5 Amperes and below about 25 Volts.

24. A system for communicating and recharging an implantable stimulator comprising:

an external interface device;

an antenna/charging coil; and

a booster coil, wherein the antenna/charging coil and the booster coil are contained within the external device;

wherein the antenna/charging coil is configured to facilitate radio-frequency telemetry communication with the implanted stimulator; and

wherein the booster coil is configured for use in zero-volt recovery operation for reviving a completely depleted rechargeable battery in the stimulator.

25. The system of claim 24, wherein the external interface device is selected from group consisting of a pillow, a cushion for resting the back against, and a chair pad for sitting on.

26. The system of claim 24, wherein the stimulator is a BPB microstimulator.

27. The system of claim 24, further comprising:

circuitry for accomplishing forward and backward frequency shift keying (FSK) telemetry with the implanted stimulator,

wherein the antenna/charging coil is configured and dimensioned to enable FSK telemetry.

28. The system of claim 24, further comprising:

circuitry for accomplishing forward on-off keying (OOK) telemetry with the implanted stimulator with the antenna/charging coil.

29. The system of claim 24, further comprising:

a current measuring circuitry for determining power consumption in the antenna/charging coil; and

an automatic power shut-off circuitry for automatically shutting off power to the antenna/charging coil when the power consumption through the antenna/charging coil exceeds a predetermined power level.

30 . The system of claim 24, further comprising:

a printed circuit board (PCB) contained in the external interface device;

a sensing circuitry included on the PCB for sensing temperature; and

an automatic power shut-off circuitry for automatically shutting off power to the antenna/charging coil when the sensed temperature exceeds a predetermined level.

31. The system of claim 24, wherein the booster coil is made from multi-stranded Litz wire, wrapped around a coil spool.

32. The system of claim 24, wherein the antenna/charging coil is made from multi-stranded Litz wire.

33. The system of claim 24, further comprising:

a coil shield which is grounded and which shield is placed as part of a coil assembly to substantially cover the antenna/charger coil and the booster coil,

wherein the booster coil that is placed in the coil assembly with the antenna/charger coil, wherein the booster coil and antenna coil are wound over a coil spool in a configuration to present at least one substantially flat side; and

wherein the coil assembly is fully encapsulated in a polyurethane housing, which housing is contained within the external interface device.

34. The system of claim 24, further comprising:

a base station;

a connection extension cable that connects the external interface device to the base station; and

detection circuitry for automatically detecting disconnection of the extension cable from the external interface device.

35. The system of claim 24, further comprising:

first and second impedance matching networks,

wherein a first amplifier power supply to the antenna/charging coil is impedance matched with the first impedance matching network; and

wherein a second amplifier power supply to the booster coil is impedance matched with the second impedance matching network.

36. The system of claim 24, further comprising:

a sensor for detecting power levels in the antenna/charging coil; and

a variable output power supply that automatically adjusts downwards when the power levels detected by the sensor detects a power level that exceeds a predetermined level,

wherein the variable output power supply is contained within the base station.

37. The system of claim 36, wherein the variable output power supply used by the antenna/charging coil ranges from between about +7 to + 25 VDC.

38. The system of claim 24, further comprising:

circuit means, located in the base station, for reducing all voltages and currents inside the external interface device to below about 4.5 Amperes and below about 25 VDC.

39. The system of claim 24, wherein the tuning frequency for inductive battery charging is 127KHz.

40. A system for communicating and recharging an implantable stimulator having a rechargeable battery, the system comprising:

an external interface device;

an antenna/charging coil contained in the external interface device, which antenna/charging coil is used for radio-frequency communication with the stimulator; and

a charging circuit for inductively recharging the rechargeable battery, wherein the charging circuit is capable of recharging the battery in the stimulator which is implanted in a patient's body up to an implant depth of about 15 centimeters.

41. The system of claim 40, further comprising:

a booster coil for implementing zero volt recovery (ZVR) for the rechargeable battery in the stimulator,

wherein the rechargeable battery is of a type that can be revived even after the battery has been depleted down to zero volts.

42. The system of claim 40, further comprising:

a base station; and

circuit means for converting supply voltages and currents in the base station to levels of voltages and currents in the external interface device that are about or below 0.5 amperes and 25 VDC.

43. A method of communicating with and recharging an implantable stimulator having a rechargeable battery, the method comprising:

(a) providing an antenna/charging coil;

(b) providing a booster coil;

(c) positioning the antenna/charge coil and the booster coil near a patient's skin over the implanted stimulator; and

(d) determining whether the rechargeable battery is in the following condition (1) completely depleted to zero volts or (2) needs recharging, but is not at zero volts,

wherein if case (1) applies, performing the steps:

(e) applying a 1.2 MHz through the booster coil in order to reset the stimulator recharging circuitry to accept 127 KHz;

(f) turning off the power to the booster coil; and

(g) applying power to the antenna/charge coil to commence trickle charging of the rechargeable battery,

wherein if case is (2) applies, performing step (g) directly, without performing steps (e) and (f).